

Landsat 10 and Beyond

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SLI in FY16 Appropriation

A 3-part program for a sustainable and responsible land imaging program through 2035:

1. **Landsat 9** (fully Class-B rebuild of Landsat 8) to launch likely late CY2020
 - Low programmatic risk implementation of a proven system with upgrades to bring the whole system to Class B
2. **Land Imaging Technology and Systems Innovation**
 - Hardware, operations, and data management/processing investments to reduce risk in next generation missions
3. **Landsat 10**, Class B full spectrum, to launch ~2027-2028
 - Mission architecture to be informed by the technology investments (2015-), leading to definition ~2020



SLI: NASA Present Status

Landsat-9 Project initiated with FY15 funds

- Directed to NASA's Goddard Space Flight Center (GSFC)
- Project Office established and substantially staffed
- OLI Instrument and L-9 spacecraft procurement actions in work
- TIRS-2 development in progress
- Launch ASAP, likely NET 12/2020 – there is sufficient (\$100M) funding authority for FY16

Technology studies underway for L-10 definition and long-term technology infusion

- Detector component development
- Overall instrument size reduction using advanced technologies
- ROSES SLI Technology call released (ROSES 2015 A.47 released 23 Dec 2015: NOI due 22 Jan 16, proposals due 30 Mar 2016)

NASA solicited, selected, and initiated science investigations focused on construction of multi-system fusion data sets (“Multi-Source Land Imaging Science”)

- “...[W]e solicit for efficient use and seamless combination with Landsat, of satellite sensor data from international Landsat-type moderate resolution (~30 m ground resolution), multispectral sources on continental to global scales. A primary focus is on developing algorithms and prototyping products for combined use of data from Landsat and Sentinel-2 toward global land monitoring. However, we also welcome proposals combining Landsat with other sources of moderate resolution data, such as IRS and/or CBERS...”
- 7 investigations selected, \$1.3M/year total, 3-year studies

Copernicus data access agreements with EU signed (including all Sentinel-2 data)



Land Imaging Evolution

While recognizing the scientific need for continuity with the 43-year Landsat record, we are seeing new trends & opportunities in land remote sensing

- *Evolving user needs for...*
 - *Improved temporal revisit*
 - *Additional spectral coverage & resolution*
 - *Integration with other modalities (lidar, radar)*
- *Increasing use of “small sat” platforms and distributed architectures*
- *Increasing number of commercial imaging systems*
- *Potential synergy with international systems (e.g. Sentinel-2)*
- *High-performance computing and increased emphasis on information rather than images*

Our challenge is to advance the measurement capability, while preserving continuity and constraining program costs



The Road to Landsat-10 and Beyond

- **USGS assessing user needs for future land imaging**
 - Requirements Capabilities & Analysis for Earth Observations (RCA-EO)
 - Documents land imaging user needs across Federal Agencies
 - Additional input from Landsat Science Team and User Workshops
- **NASA Earth Science Technology Office (ESTO) managing technology developments for SLI**
 - Reduce the risk, cost, size, volume, mass, and development time for the next generation SLI instruments, while still meeting or exceeding the current land imaging program capabilities
 - NASA ROSES proposal opportunity now available
- **NASA Space Technology Directorate continuing development of a pathfinder satellite servicing mission [RESTORE-L] with FY16 funding**
 - Refuel Landsat-7 (or another U.S. Govt-owned satellite in low-Earth orbit), potentially extending the Landsat-7 lifetime



SLI-Technology Overview

Earth Science Technology Office (ESTO)

- Tasked by the NASA Earth Science Division (ESD) to manage technology developments for the Sustainable Land Imaging (SLI) program

Overall objectives of the SLI-Technology (SLI-T) program

- Reduce the risk, cost, size, volume, mass, and development time for the next generation SLI instruments, while still meeting or exceeding the current land imaging program capabilities
- Enable new types of observations that improve temporal, spatial, and spectral resolution capabilities for SLI measurements
- Enable new SLI measurements and architectures which improve operational efficiency and reduce overall program costs of our land imaging capabilities



Example of a Future Technology

Point of Departure - *Past*

- Three 5-degree Field-of-View Offner Spectrometers

Reduced Envelope - *Present*

- Two Dyson spectrometers compactly packaged

Miniature - *Future*

- Photonic spectrometer utilizing planar waveguide circuits (spectrometer-on-a-chip)



SLI-T Near-Term (FY15) Activities

FY 15 investments addressed areas identified for follow-on work from the earlier SLI Reduced Instrument Envelope Size (RIES) Study

- **Calibration**
 - Compact onboard calibration system
 - Vicarious calibration system
- **Performance analysis**
 - Compact telescope performance
 - Hyperspectral imager stray light and optical performance analysis
- **Detector performance and characterization**
 - Feasibility of bolometer use for Earth science instruments
 - High speed focal plane electronics and detector characterization
 - CCD performance characterization



SLI-T FY16 Activities

NASA's Research Opportunities in Space and Earth Sciences (ROSES) solicitations utilized to solicit future instrument systems and subsystem technologies

- Uses Landsat science community for inputs and requirements
- Utilizes grants, cooperative agreements and contracts, as appropriate

Advanced Technology Demonstrations (Systems/Instruments)

- 80% of SLI-T funding for the Landsat-Next mission
- Available for infusion to Landsat-Next, future Earth Venture, or technology demonstration opportunities
- Plan 5-year tasks (1-year base + four 1-year options)

Technology Investments (Subsystems/Components)

- 20% of the SLI-T funding for Landsat-Next+1 mission
- Plan 3-year tasks (1-year base + two 1-year options)

ROSES call released on December 18, 2015

- ROSES15 A.47 NNH15ZDA001N-SLIT
- Proposals due on March 30, 2016
- Selections planned for August 2016





Landsat

Continuing to Improve Everyday Life

<http://landsat.gsfc.nasa.gov>

